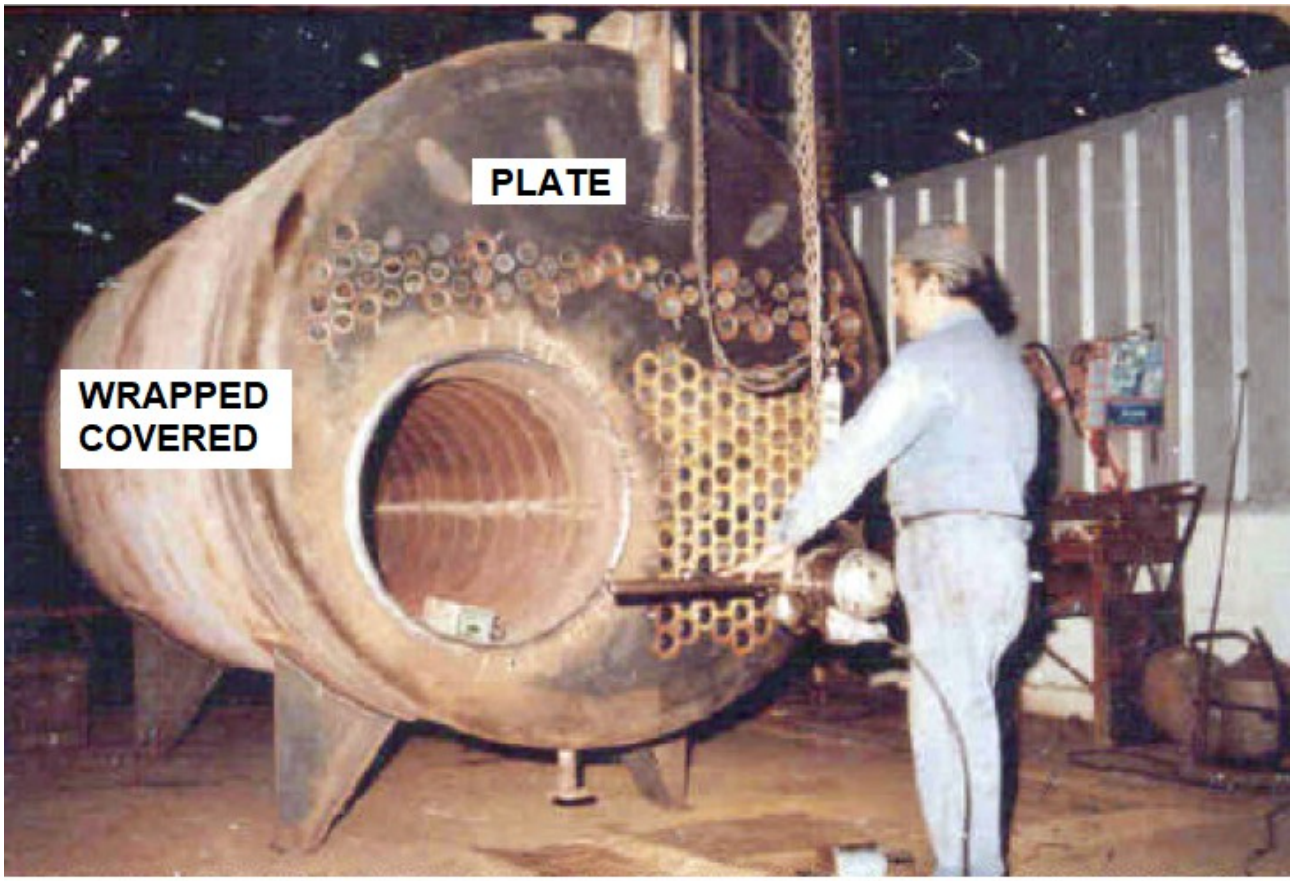
CHAPTER 21: BOILER TUBE MANDRELLING



MANDRILLING BORING TUBES TO PLATES (HOMO-TUBULAR BOILERS)

Calculating the percentage reduction (flattening) of the tube over the plate hole based on the tube wall thickness (the tube must be the correct size for the plate hole).

Since a percentage reduction can be predicted according to the material being mandrel, that is, we can establish the final internal diameter of the tube after it has been mandrel to the plate.

Remember that excessive mandrelling or "flattening" is undesirable. It is preferable to have insufficient expansion and, if necessary, "adjust" without overdoing it.

An excessively mandrel tube can only be replaced or fitted with a smaller diameter support collar, which in some cases is not advisable, as it can cut off water flow in a water-tube system or cause it to burn in a fire-tube system.

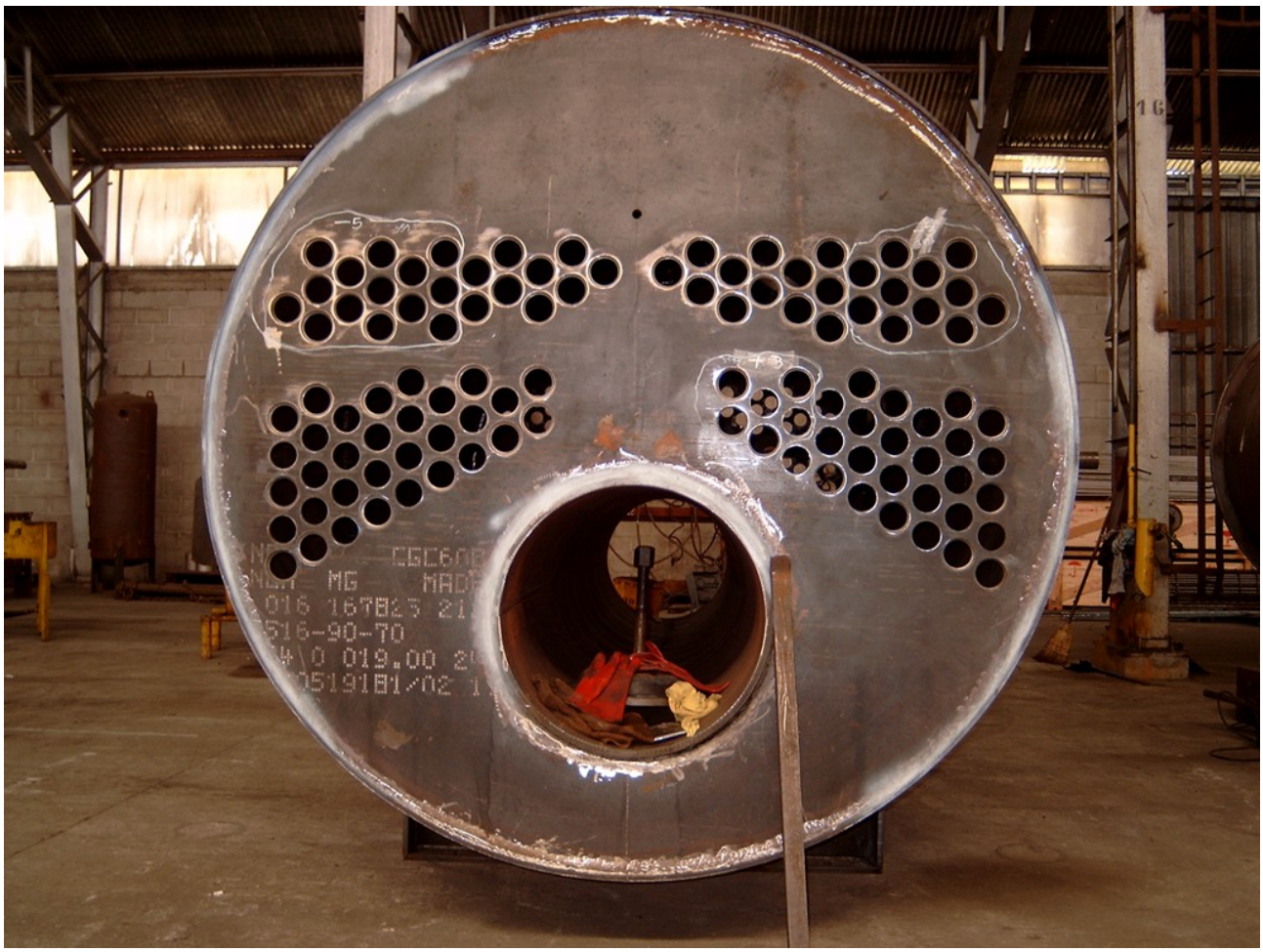
Admissible or recommended percentage reduction:

Copper and Copper-Nickel..... 8-10% reduction
Steel, Carbon Steel, and Admiralty Copper..... 7-8% reduction
Stainless Steel and Titanium..... 4-5% reduction

This percentage reduction means that when the tube is placed on the plate, both are prepared for mandrel boring: cleanliness, annealing of the tube (if necessary), and on the plate: a perfect and clean hole, etc.

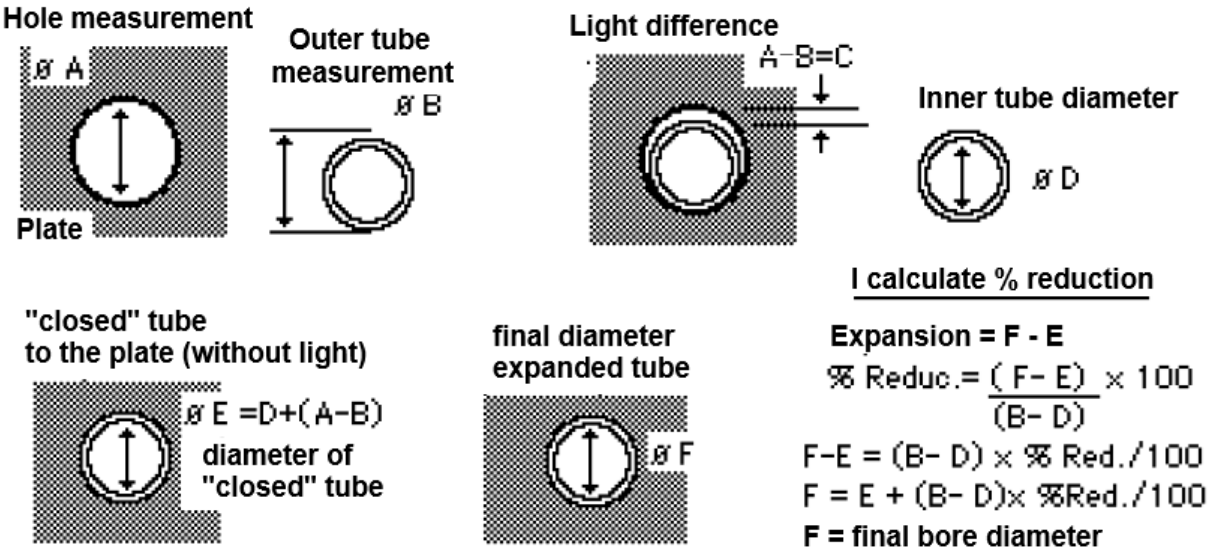
Then we must "bring" the tube to the plate with the mandrel until the light disappears (they "make contact").

From this moment on, any further movement of the mandrel will "compress" the tube against the plate (stiffening the tube), and the reduction of the tube in this last operation becomes the percentage reduction that we must respect, since an "excessively" mandrel-broken tube (a reduction percentage higher than recommended) instead of becoming firmer, will actually become weaker.



Each material will require the appropriate mandrel.

To calculate the final internal diameter measurement of the tube after mandrel, carefully follow the instructions below:



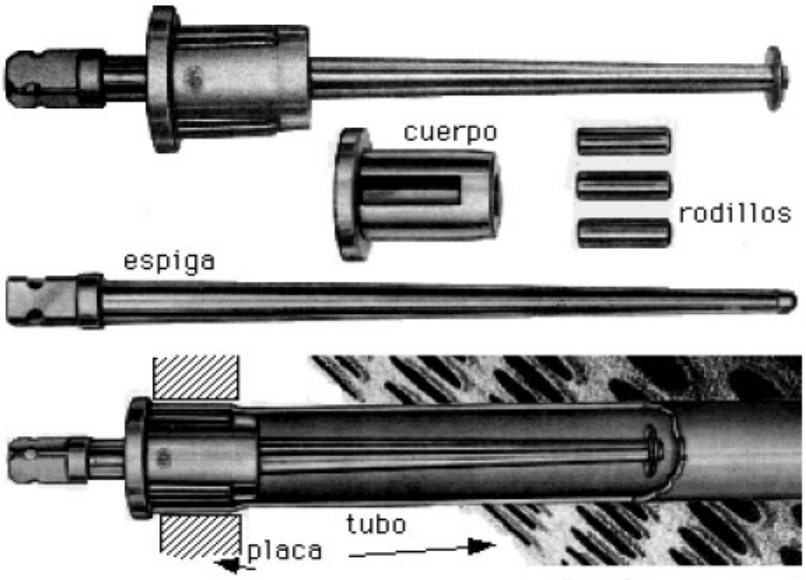
If there is a way to measure the "force" needed to reach that measurement on the "spindle" of the mandrel (measuring the "torque"), we perform it a few times until we can be sure that we can repeat the mandrelling with that maximum "force", we will be in a position to mandrel the following tubes guided by that limit (there is special equipment for this, with "torque" measurement or automatic preset "torque" limit, with electric motors or pneumatic motors).

It is important to keep the mandrels clean and lubricated with a high-pressure grease (generally molybdenum-based).

Pay attention to the tube's termination on the plate: whether it is flanged, flared, straight, flush, or welded, as the tube provides mechanical support for the plate. Flaring serves a dual purpose in some cases, both as support and as a guide for water circulation.

On the flue gas (flame/smoke) side, excessive extension or lack of flaring ("upset") in fire-tube boilers on the hotter side can be counterproductive due to the high temperatures that can burn the tube or allow it to loosen on the plate (as the mandrel section heats up due to excess surface area).

Furthermore, if the surface finish of the tube end is not properly completed, it will be the beginning of a future possibility of longitudinal cracking of the tube. Therefore, the finish must be smooth, without sharp edges, cracks, or other irregularities.



3-ROLLER TUBE EXPANDER (MANDRIL)

The hole in the plate must be polished and sufficiently round. If the deformation is not significant, it can be reshaped with a mandrel to achieve a rounded shape.

Three-roll mandrels work best where the plate holes are not perfectly round, while five-roll mandrels are recommended for perfectly round plates made of harder materials.

If you are inexperienced in tube mandrel, prepare a piece of iron sheet of the same thickness as the plate, drill several holes of the same size as the plate, and practice mandrel until you achieve the desired result and its appearance matches that of the boiler being mandrel.

It is advisable that a job of this scale be carried out by a company specializing in this field (with technical expertise).

There are other ways to control the amount of tube mandrelling on the plate, one of them being the use of a dial indicator, which is placed on the tube to be bored and its "point" rests on the plate.

MANDRILLING TUBES IN A WATER-TUBE BOILER DOME

The expansion is measured by the movement of the dial indicator as the tube "stretches" when it is held in place by the boring (after measuring the diametral deformation indicated at the beginning on the first tubes).

Today, in almost all fire-tube boilers, the tubes are mandrel-grooved and welded to the plate.

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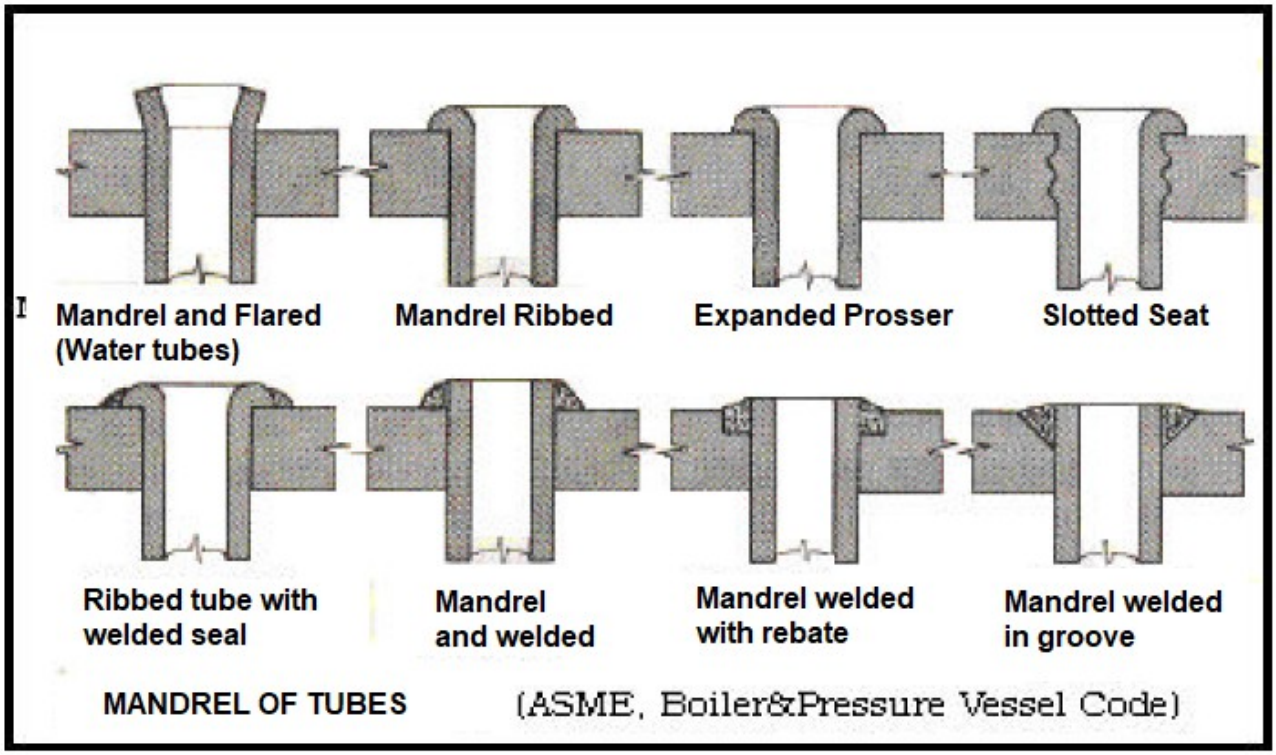
The tubes are welded to achieve a good seal, but some tubes are welded deeper, as these are the "stay" or support tubes between the plates (meaning they withstand the pressure exerted on the flat plates).

Although the tubes will be welded, they must first be mandrel-grooved. After welding, they are mandrel-grooved again to loosen the tensions generated by the welding process and to retighten the mandrel that loosened during welding (the tube having reached a certain temperature).

Since the mandrel acts as an anchor for the tube to the plate, and the weld acts as a seal, and in the case of stay tubes, the weld also serves as an anchor,

if the tubes were not mandrel-grooved, problems would most likely arise over time, ranging from weld failures due to insufficient anchorage to corrosion in the gap between the plate and the tube.



These welds must be done very carefully and with the appropriate electrode (as otherwise the plate can be damaged or problems with cracks or corrosion can arise). It's important to remember that at the hottest gas inlet of the plate:

The gases, which generally enter after leaving the combustion chamber, have a temperature of almost 900°C (1652°F), causing a significant increase in the metal's temperature if it is not properly cooled by the water inside the boiler.

The tubes should not protrude beyond the plate into the gases by more than a specified amount, generally a maximum of 3 mm.

There should also be no overheated weld spatter or cracks in the tube or weld (as all of these will cause the material to suffer high-temperature corrosion, cracking the plate or tube,

or even loosening the tube on the plate, practically tearing off the sealing weld and negating the mandrel effect, due to the metal's plasticity at high temperatures). temperature.

Previously, with only mandrel-punched tubes, these tubes at the gas inlet were "flared," meaning the extension or end of the tube was neatly pressed onto the plate, so that no uncooled tube was exposed to the hot gases.

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URUGUAY

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